ABSTRACT

Disclosed is a method and an apparatus enabling operation of balanced phase shifts providing uniformity that the insertion loss do not show variation with the derived angles in phase shift. The invention incorporates a resonator supporting nonreciprocal wave propagation. The resonator is divided in two equal parts showing symmetry so that the change in electronic parameters from one part of the resonator counter balances the other part, thereby causing no change to the resonance condition. Amplifiers are thus not needed by the phase-shift operation. Electronically active materials, such as ferrites, ferroelectrics, and/or varactors, are utilized, and the phase shifter device can be fabricated assuming a variety of transmission-line geometries, such as microstrips, striplines, waveguides, coax lines, parallel wires, coplanar waveguides, image lines, fin lines, and slot lines, providing versatility and convenience in applications.